No. 36 December-January 1991

solplan review

the independent newsletter of energy conservation, building science & construction practice

Inside . . . .

We are more aware of the importance of a clean environment. This applies to the interior of our homes as well as the earth's environment. Contrary to common perceptions, it is easy and inexpensive to achieve. We review the principles of filtration, the types of filters available and how they can be used in the home.

Attic turbine ventilators are used to cool down the house. But do they really work? A recently completed study shows that in our climates they really don't do that much.

Radiant barriers are still being promoted. A study in Edmonton measured the performance of the radiant barriers. The performance results are not what the sales people want to hear.

Other items include a solution to squeaky floors; a report on B.C. Hydro's energy conservation Power Smart program; CHBA-TRC news, a report on a new light fixture connector that promises to give real cost, an item on the ReCRAFT Home 90, and more.

Contents . . . .

Filtration for Clean Air

From the Publisher

The New Year is traditionally a time to take stock and reflect on the past and look to the future. 1991 seems to be starting out on a sour note, with war clouds in the Middle East, an unpopular new tax, loss of confidence in the most unpopular government in our history, and a general feeling of bitchiness and pessimism. This is compounded by problems of an economic slowdown.

What we have to keep in mind is that economic activity is fuelled by our collective feeling. If we have confidence in ourselves and feel good, then things won't be quite as bad as they may appear. If we think that things are going to get worse and enough others think so too, then it will get worse. You cut back just as everyone else does and eventually everybody has cut back. It becomes a self fulfilling prophecy.

We must look on the positive side. As the song says, you want to "accentuate the positive . . ." We have a lot going for us in this country even if there are times it doesn't seem like it. Yet while there is a slow down, most people still are working regularly, and life carries on.

I am not advocating pasting a fake smile (like the snake oil salesmen) and ignoring any dark clouds as there will always be slumps. A positive outlook by itself won't put money into your pocket if you're out of work, but it will help speed the time that we do get the work.

The new world reality is that we have to look at restructuring the economy. We must become more self reliant in our own communities. The global mega corporation will eventually go the way of the dinosaur, but we can't let it take us down with it. Growth for growth's sake can't go on for ever - the earth's environment can't take it. Nor is it moral for us to exploit the poverty of the third world to get us more cheap stuff.

We must pay more attention to quality of the environment, of life in our community, of workmanship. Lasting community values and quality of workmanship are more important than merely producing more of everything. Better value rather than mere quantity. This is something in which the building industry could lead the way.

Best wishes for a healthy and prosperous 1991.

Richard Kadulski
Publisher

solplan review

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Clean Air: getting the most out of Filters

Richard Kadulski

Most people are aware of dust in the home. Many have the feeling that forced air systems are dusty, so that those who are sensitive or have dust or pollen allergies try to avoid forced air heating, opting to go to radiant or baseboard type systems.

It may come as a surprise to many but the best way to ensure clean, dust-free conditions in the home is to use a system that can move large quantities of air past good filters. The heating system thus could be forced air, or if non-forced air heating is used, a substantial air handling system must be used.

Air contains small particles made up of many different products of varying sizes we usually call dust. Particles include smoke, microscopic organisms (mould spores, mites and a variety of microbes), fibres given off by clothing and furniture, floor coverings, pollens, animal dander and dirt. In other words any bits of materials from any product that can wear down. (The black grit one gets in urban areas or near highways is tire rubber that has been worn off the passing traffic.)

Other sources of pollution are gases that may be toxic or only irritants. They may be carbon dioxide, carbon monoxide, hydrogen sulphide, aromatic hydrocarbons and many others - a chemical soup. The source of the gases can be combustion (flue gas spillage), natural chemical reactions in the building or the off gassing of products (the new home or new car smell is caused by the off gassing of chemicals as they set and age). Fortunately in most cases the concentration of the chemical soup is low. But even low concentrations some combinations can be toxic if exposure is maintained over a long time.

Today we are more aware about the importance of healthy environments. To ensure good air quality indoors we want to be able to clean and reduce the number of unwanted particles in the air. Filtration is essential to achieve this. To be effective the filtration must be able to do the job required. To establish the kind of filtration needed or desirable we have to know the source of the particles we want to remove and their size.

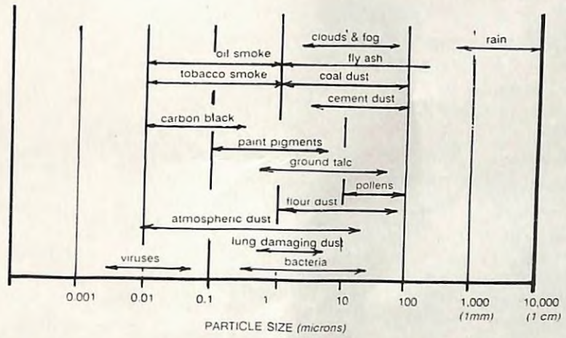


Figure 1 Relative size of particles in the air. The eye cannot see particles smaller than about 10 microns

How to clean air?

The most important principle is that the air must be moved past a filter that is capable of removing the pollutant we don't want. Think of the filter as a strainer that picks out the offending particles. As the particles are filtered out and become trapped on the filter medium, the pollutant bed itself (up to a point) makes the filter more efficient. Past a point the garbage that has been filtered out becomes so dense and creates so big a resistance that very little air flow goes through the filter. At that time it must be cleaned or replaced.

Even relatively inefficient furnace filters can be quite effective for smaller particles at some times. We've all probably seen the furnace filter that hasn't been touched for years, encrusted with a thick layer of crud.

Too big a build up creates a big resistance to air flow, until very little gets by. In commercial installations, pressure drops are used as a measure for how full the filter is.

What kinds of filters?

There are 2 basic types of filters. The most commonly used filter physically removes dust particles from the air. It requires the movement of the dirty air past the strainer which does the job by physically stopping the particles, as they stick to the media, or by electrically charging the particles and collecting them on a collector, as is the case in the electrostatic filter.

The second filter removes gases by chemical processes. Most commonly it absorbs the offending compounds. The most common example is the charcoal filter. Fortunately, the circumstances where these filters are needed are not as common.

How to choose a filter? What is most efficient?

To answer this question, you need to know what you are trying to filter, and how big the particles are. Think of it like the screens used by gravel pit operators - they have a range of meshes, each progressively finer, until one only allows fine sand to pass through. Within the limits of each size, each screen is very efficient at holding back stones and material of a given size. The same applies to filters.

Before we get to the discussion of which filter is most efficient or cost effective, we should understand how filter performance is decided, as it is important to realize that a 30% efficient filter could be much more useful than a 90% filter. Sound unreal?

How is filter efficiency tested?

There are several test methods used to define filter efficiency. Each test is effective for a range of particle sizes.

In general, the smallest particle a human eye can see is around 10 microns in diameter (one millionth of a meter). The dust **arrestance** test (ASHRAE Standard 52-76 Arrestance) measures the effectiveness of filters to remove particles of a specially prepared sample of air and dust (this is also known as the Arizona road dust test). This test is effective at measuring the filtration capacity for large particles (down to about 5 microns).

The **atmospheric dust spot** test (ASHRAE Standard 52-67 Atmospheric) is able to determine the effectiveness of filtration for particles as small as 2 microns. This represents a major portion of atmospheric dust.

The **DOP** test (MIL Standard 282) is effective at testing high efficiency filters that are designed for 10 to 0.5 microns in diameters.

What are the particle sizes we are concerned about? Figure 1 shows the range of particle dimensions generated by a variety of products and processes. Our body, through the respiratory system (nose, windpipe and lungs) can filter out particles greater than 5 microns in diameter, and some down to about 3 microns, mostly through the lining in the nose and windpipe. When you are in dusty environments, you sneeze and have to blow your nose often, it is your body's filters cleaning themselves.

Particles smaller than 3 microns can't be filtered out by the body and enter the lungs, where they settle out on the lining of the lung. Once these particles are in the lung, some can eventually cause serious diseases and ultimately death. In a polluted environment, the greatest number of particles will be smaller than 3 microns.

Types of filters

Filters can generally be grouped into four broad categories.

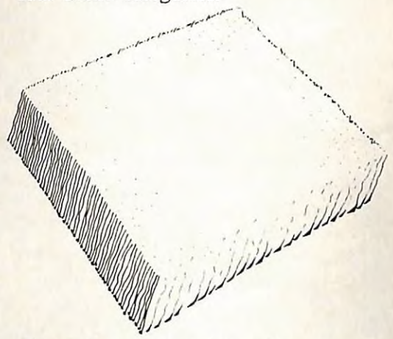
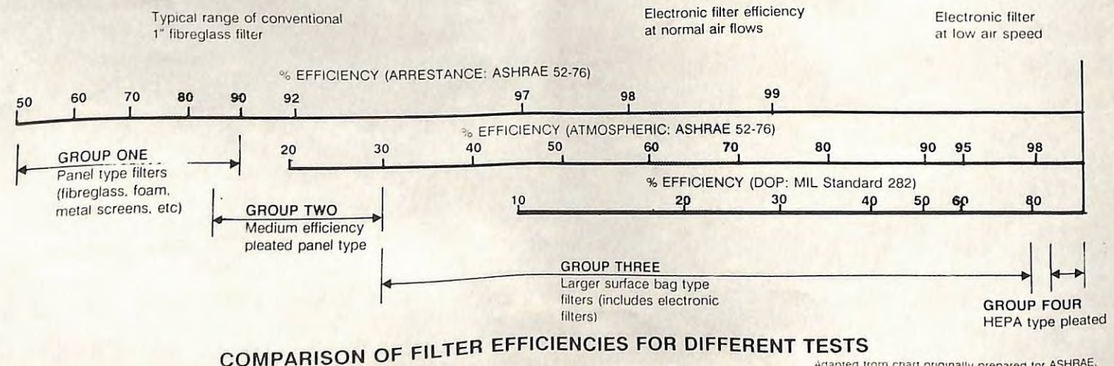


Figure 3 Basic panel type filter

Group One are panel type filters that may be made of spun glass fibres, open cell foam, expanded metal meshes, and woven synthetic fibre screens. This type of filter is most commonly used as filters for furnaces and HRVs. These filters may be up to 90% efficient at removing particles as small as 10 microns. (fig. 3)



COMPARISON OF FILTER EFFICIENCIES FOR DIFFERENT TESTS

Adapted from chart originally prepared for ASHRAE, published by B.C. Air Filter Ltd., Vancouver, B.C.

Figure 2

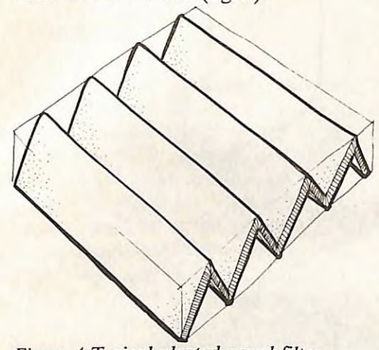


Figure 4 Typical pleated panel filter

Group Two are pleated panel type filters made of fine non-woven synthetic or synthetic-natural fibres. They are often referred to as medium efficiency filters. These filters may be up to about 92% efficient ('arrestance') at removing particles over 10 microns, and 30-50% efficient ('atmospheric') at removing particles down to about 5 microns. (fig 4)

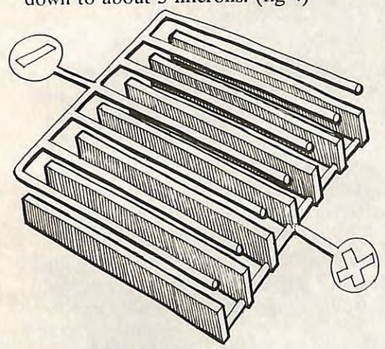


Figure 5 Electronic filter

Group Three filters have a larger surface area than the pleated filters in group two. They may be as deep as 24" or more, and are often referred to as "bag filters". They are made of similar materials as the group two filters, but have a finer fibre mesh and because of the larger surface area are much more efficient. Electronic filters also fall into this category. This range of filters can be up to 98% efficient ('atmospheric') at removing particles down to 5 microns, and up to 80% efficient (DOP) at removing particles as small as 0.3 microns.

Group Four filters, sometimes referred to as HEPA filters are similar to the group three filters, but they use ultra fine fibres. This class of filters is typically used in clean room applications - such as Hospital operating rooms, electronic clean rooms, etc. These filters may be able to remove as much as 99.999% of all particulates.

Another group of filters deals with gases. These use activated charcoal or other chemicals to remove odours and toxic gases. These filters generally have granules of the compound that adsorb the gases we are concerned about. Fortunately, in most residential applications these types of filters are not needed. Activated charcoal is often used if needed, as the charcoal is very efficient at picking out common smells.

Recirculating range hoods rely on charcoal. Unfortunately, there is so little charcoal in these filters that unless they are recharged regularly (up to once a month if used frequently) they don't do anything.

In areas that are subject to atmospheric inversions and where many people burn wood, charcoal is an effective filter for use on the intake in continuous ventilation systems to keep out the smoke.

Figure 2 shows the range of atmospheric dust, and what different filters can do to remove it.

What filter to use?

Each type has its features. Filter selection depends on how dirty the air is, and what has to be filtered out.

The common low efficiency furnace filters are there primarily to protect the furnace blower from large particles that might damage the blower. These filters are the cheapest. But they are not very effective which is why people think forced air systems are dusty.

The typical throw-away fibreglass filters being less than $2.00 each. (The washable, reusable foam or metal mesh filters are more expensive but do a similar job).

Medium efficiency filters are very effective for most residential applications. At about $16 (depending on size) they are more expensive. These filters are not reusable, but depending on how dirty a location is, they may be good for up to about 1 year. Because these filters may be deeper (2-4 inches or more) some changes to the ducts may be necessary. They come in the same size as many residential electronic filters, so if the system has been prepared to receive an electronic filter, a medium efficiency pleated filter can be used in its place. *For most applications, this is the recommended BEST BUY.*

Higher efficiency filters are very efficient. They use deeper sections of filter material (as much as 24" or more). These are sometimes referred to as bag type filters. They cost in the range of $65, and require preparation of the ducts to allow their fit, but in a typical home one filter may often last up to 2 years. This type would be used where a very clean environment is desired. This is the type of filter that is now being used regularly in commercial and institutional installations.

Electronic filters are the most expensive: $650-700. They require changes to the ducts to provide a slot for them and electrical wiring. They are effective, but as they become plugged, they become noisy as the

electric charge zaps passing particles. If they are not cleaned regularly they may generate ozone, which in larger concentrations is an irritant.

Using filters: case study.

I have recently designed a home, currently under construction in the Vancouver area, for a family several of whose members have respiratory problems. Dust, smoke and mites are a major concern. As a result, special care is being taken to used clean materials with a minimum of synthetics and ceramic floor tiles in most of the house. No draperies will be used. Heating will be provided by electric floor radiant cables to ensure comfortable, warm floors.

To clean the air, an air handling unit is being installed to continuously re-circulate the house air, passing it by a 24" deep bag filter. Fresh air will be brought into the house through a heat recovery ventilator to be distributed through the house by the air handling unit.

The house is being built to meet R-2000 airtightness standards. A tight draftfree building further increases dust control as there is a minimum of uncontrolled infiltration of outside air.

Because the house is located close to several oil refineries, in an area subject to occasional temperature inversions and concentrations of urban industrial pollution, we are adding a charcoal filter to remove any smoke and fumes that might be bought into the house through the heat recovery ventilator.

The principles and elements being used in this house are not extreme. The same concepts can be applied to any house for a modest cost, especially if there is a forced air heating system.

Filtration with forced air heating

Air filtration is a natural for houses with forced air heating systems, as good filters can easily be added. The filters should be placed in the return air stream. The furnace blower should be running continuously (on a two speed motor, running continuously at low speed, cutting to high speed when required by the furnace).

Electronic air filters are one option. However, in the same space as the electronic filter, and for much less money, a medium efficiency filter can be used. I have noticed that Honeywell, the leading manufacturer of electronic filters, is now also distributing medium efficiency filters.

However, filters with forced air systems must be installed correctly or they will not be as effective as they might be. In forced air systems, a convenient place to locate these filters is in the return air plenum, next to the furnace.

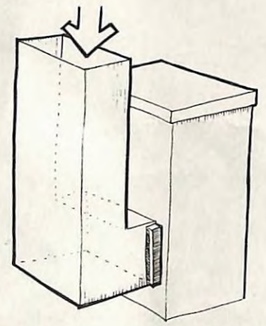


Figure 6

Figure 6 shows a typical forced air system set-up. The quick and dirty, cheap solution is to use rectangular return air ducts to the furnace, but air flows don't like sharp corners which contribute to turbulence. The better way to do it is to use rounded sheet metal sections. (fig. 7)

The proper way is to use a duct section with turning vanes. (fig. 8) Turning vanes keep air flows smooth and parallel so that the air can pass evenly across the whole surface of the filter. If there is turbulence, or the air flow is not even, you will get most of the air passing through only a portion of the filter.

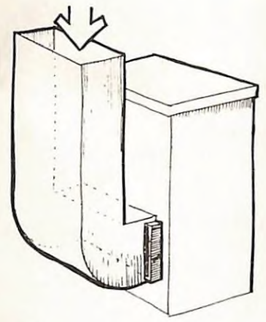


Figure 7

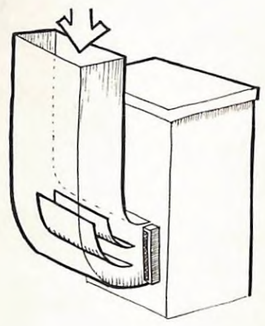


Figure 8

Air flows are similar to flowing water. Think of it as the water eddies in a stream. Silt or debris carried by the water drops out around the bends because of the uneven water flow. These pools have very little water flow, while others may have too much.

Uneven air flows across the filter means that the filter is not being used efficiently, as only a portion of it will be doing the work.

Attic Turbine ventilators

Richard Kadulski

Rooftop turbine ventilators are used to remove hot air from attic spaces during the summer and reduce overheating. It is also suggested that ventilation through the attic will remove any moisture that will find its way into the roof space, and thus avoid moisture problems in the winter.

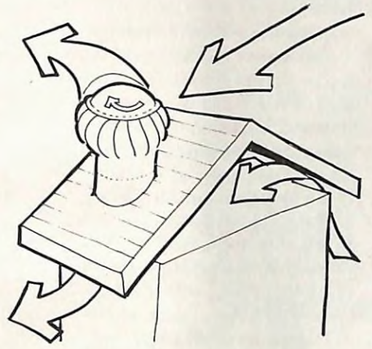
Do they really work? Do increased air flows through the attic cool the wall ceiling intersection be enough in the winter to cool the inside drywall and result in condensation on these surfaces?

In SOLPLAN REVIEW No 17 we reviewed a study that investigated attic moisture problems in northern housing. In many cases attic ventilation actually creates structural problems in the north, as the negative pressure in the attic can draw warm moist air out of the house into the attic where it can condense and create serious moisture damage. The consequences for southern houses are less serious.

But is interesting to note that there is very little information on the air flow properties in attic spaces. One of the first studies to search for answers to these questions was done recently in Edmonton. It was a two part study to find out just how turbine vents work.

A test was done in a wind tunnel to try and see if a theoretical model could be created to predict how they work. The second part was to measure the operation of the turbine in an actual installation.

The theoretical model came up with the conclusions that a turbine ventilator would increase the air exchange between the attic space and outside by 30%. The conditions in the wind tunnel, however, did not allow for unequal pressures above and below



the ventilator as would exist in an actual house. The laboratory tests can't give enough information to predict the probability of moisture problems that might be caused by the attic turbines.

The theory suggests that a single turbine won't increase airflow rates enough to create problems. It also suggests that several turbines would not have a much bigger impact than a single unit.

But what about field measurements? Experiments in the test house showed that air flows would be about 2½ times greater at any given wind speed than what was calculated and observed in the wind tunnel tests. It was noted that attic ventilation rates, whether or not a turbine was installed, were dependent on the amount and direction of wind. The airflow rate increase with the turbine ranged from 5 to 50%. Averaged over the range of wind directions and seasons, the turbines were noted to increase ventilation rates by about 15% (from an attic air change rate of 5.3 to 6.1 air changes per hour).

It was discovered that air flows through the attic are governed by the resistance to air flow created by the soffit vents. What is important is the free area of soffit vents, the sheltering of the soffit by other houses, trees and other obstructions and wind speed.

In the test house the vented soffits were on the north and south sides with plywood gable soffits on the east and west. During periods when winds are from north or south, attic ventilation air flows in through the upwind soffit and out the downwind soffit and ventilator. The turbine ventilator was more effective when winds were from east or west.

With measured air flows through the attic, without the turbine ventilator,

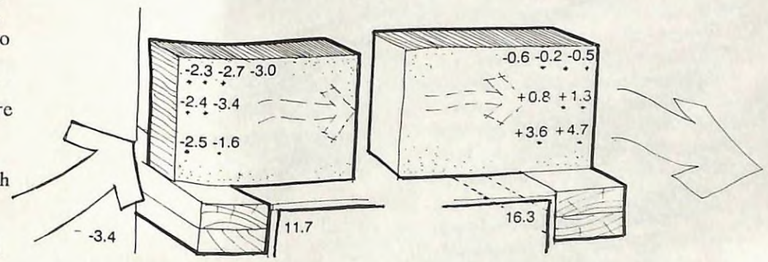


Figure 1. Temperatures through the attic insulation at the wall/ceiling intersection (R10 batt insulation). Temperatures are °C with a 20 km/hr wind and the turbine ventilator in operation.

averaging over 5 air changes per hour,it is questionable if turbine vents are needed at all.

Two Yellowknife NWT townhouse projects. In one the builder has got carried away with roof top vents.

The other interesting data that was measured was the effect of the turbines on attic temperatures. The main reason people install them is to remove warm air from the attic in the summer. Do they?

It's not that easy to determine as temperatures are not just a factor of air flow, but also outside temperatures, roof surface temperature and amount of solar radiation hitting the roof.

The reduction of heat transfer into the house does not just depend on the air temperature, but also on how much radiant heat is transfered from the underside of the roof sheathing to the top of insulation. If the radiation component is large, lowering the air temperature won't reduce the heat transfer into the house as much as one would think.

The measured data in the test house showed that the turbine ventilator reduced the attic temperature an average of 0.4°C over the summer period. In homes with conventional levels of roof insulation there would be very little reduction in the amount of heat flow into the living space because of the presence of the turbine ventilators.

But the air flow will also happen in the winter, through the ceiling insulation over the outside wall. The temperatures within the ceiling insulation over the wall were found to depend on the outside temperature, wind direction and wind speed. The fibreglass insulation offers little resistance to air flow through it (after all, the same material is used in the cheap fibreglass furnace filters).

How cold did the intersection get? It varied on the conditions, but it was noted that with typical winter indoor conditions (20°C, 40% RH), there were only a few periods where condensation could occur, but because the periods were short, none actually took place. Figure 1 shows the measured temperatures through the insulation, on the upwind and down wind side of the house. You can see how little resistance is offered by the insulation, and how the airflow actually sucks heat out of the attic.

The heat flow measured at the ceiling locations showed that insulation stops that prevent large airflow through the insulation (by ducting it over the insulation) would drastically improve the insulation values.

The moral of the story? Turbines if you must, but if you want to save some money, don't bother.

"Evaluation of the Performance of Attic Turbine Ventilators" prepared by J.D.Dale and M.Y.Ackerman from the Department of Mechanical Engineering, University of Alberta, with funding provided by Alberta Municipal Affairs.

GST Checklist

By now you will have already run into the new Goods and Services Tax. We don't want to get into a discussion of the tax here, but offer the following checklist of things to look for on invoices you receive from suppliers.

Larger builders have full accounting departments to look after the details, but smaller builders who do most of their own paper work should take the time to set up procedures to keep track of the tax.

Remember: for businesses there is no GST cost. You pay it, you collect it on your sales, and you recover the GST you paid. Only the end consumer pays it (and there is a rebate for the new home buyer, but the lawyers will handle that paperwork).

To ensure that you get all the credits due to you, if you are ever audited, make sure that all suppliers provide the following information on their invoices:

Purchaser's business name
Seller's GST registration number
Date the GST paid or due
Total invoice amount
Total amount of GST charged
Terms of sale (COD or credit)
Description of goods or services

Major suppliers will have this in order. It is your small suppliers and independent sub-trades that may not. A business making less than $30,000 per year does not have to register, nor need collect the tax. This may apply to a few individuals who provide services, especially on a part-time basis. If a supplier tells you he falls into that category and does not have to collect the tax, get a written statement from them saying that, and keep it with your invoices. If you don't, the GST police, if they audit you, will make *you* pay for it.

Sorry!

Subscription rate change:

We hate to tell you this, but as you are aware, costs are forever going up. We have been advised by dear Canada Post that our postage rates are being increased by 50% this year! Other production costs have also increased in the time since our last price adjustment 3½ years ago.

It is with regrets that we have to advise you that the subscription price of SOLPLAN REVIEW will be going up.

Effective March 1, 1991, the new rate will be:

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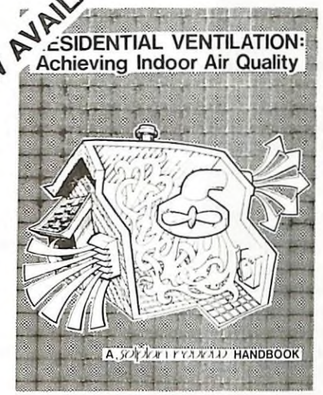

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4. Basic Ventilation Systems described
5. Codes and Standards: what they call for and how to comply
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WRITTEN BY: Richard Kadulski; Illustrated by Terry Lyster; Technical consultants: David Hill and Yvonne Kerr.

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CALENDAR

March 4, 5, 1991 ENERHOUSE '91 Airtightness, Air Quality, Advanced House, Ventilation, Moisture Problems, Windows, Lighting, Passive Solar, Radon, Construction Problems, more. Of interest to builders, renovators, contractors and other housing officials. For information: Residential Programs Section, Nova Scotia Dept. of Mines & Energy
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FAX (207) 780-5129

April 25, 26, 27, 1991 Builder's Forum: Training for Tough Times. see March 7, 8, 9. Information: (604) 432-7112

May 12 - 15, 1991 Canadian Home Builders' Association National Conference, Montreal, Que. For information: CHBA National office: Tel: (613) 230-3060

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Ottawa, Ont. K2P 1L5
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Attic Radiant Barriers

Richard Kadulski

Radiant barriers are an energy conservation concept being heavily promoted in the USA. They are thin aluminum foil sheets that have a low emissivity. Used in the attic they can reduce heat flow between the roof sheathing and the attic floor, reducing summer overheating.

In hot (cooling dominant) climates attic radiant barriers are used to reduce summer cooling loads by reducing heat gain through the ceiling. (SOLPLAN REVIEW No. 21) Under some conditions, they can also reduce heat loss in the winter.

Because of their effectiveness at reducing summer overheating, and the fact that they are a low cost product with high mark-ups, there has been aggressive marketing of radiant barriers in the USA for heating season use as well. Unfortunately, too many of the claims made are gross exaggerations. Some are now trying to market these products in Canada.

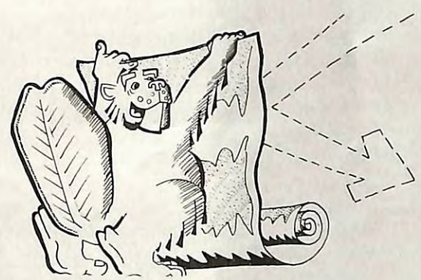
How do the radiant barriers work in cold northern climates? Do they reduce winter heat loss?

A study done in Edmonton answers these questions.

The objectives of the study were to measure the heat loss of attic radiant barriers; to evaluate the installation costs compared to energy savings of the attic radiant barriers; to determine if radiant barriers have any effect on ceiling moisture; and to find out how much roofing material temperatures are increased by radiant barriers installed under the top chord of roof trusses.

Laboratory analysis of the thermal and moisture performance of radiant barriers were carried out in a cold room.

Moisture accumulation on the radiant barrier was simulated by allowing warm, humidified air to escape from the heated space through the drywall on the warm side. In addition field tests were done in an unoccupied test house. Half the attic



floor was covered by a radiant barrier and half left uncovered. Ceiling heat loss, roof sheathing and attic air temperatures were monitored in each half of the attic over a winter season.

Roof overheating tests were conducted during the summer months with a radiant barrier stapled to the underside of the top chord of the roof trusses. Shingle and roof sheathing temperatures were monitored through the summer test period.

Do Radiant barriers work?

There is a small improvement in the thermal performance of attics with radiant barriers, but the reduction in overall energy use for cold climates is very small. In warm climates, where cooling is more important, they have a greater impact.

Laboratory and field tests showed that the overall ceiling resistance, with and without a radiant barrier, depended on the temperature difference between the roof sheathing and attic insulation. When the sheathing was colder than the attic air (at night), radiant barriers reduced the ceiling heat loss by reducing the radiant exchange between the ceiling and the roof sheathing.

When the sheathing was warmer than the attic air (during a winter day), the radiant barrier actually *increased* the ceiling heat loss by blocking the helpful radiant heat gain between the sheathing and ceiling. The results can be summarized as an effective ceiling resistance. Radiant barriers *increase* the resistance up to 15% over that of uncovered insulation when sheathing is colder than the attic air, but *decrease* the resistance up to 43% when sheathing is warmer than the attic air.

Averaged over an entire winter, there was a net reduction in ceiling heat loss of about 5%. But as the ceiling is a small part of total heat loss, this was less than 1% of total energy use (including air infiltration). Because energy use can vary from year to year due to weather and user patterns, it is not likely that this reduction would even be noted. In new houses with higher insulation levels it is unlikely the savings would be as much as that observed in the test building which only had R12 batt insulation in the ceiling.

What about the cost?

In Alberta the estimated installed cost is about $1.50/sq.ft. (The USA supplier's estimate is $1.00/sq.ft.). For the test house the radiant barrier would cost about $780 to produce an energy savings of about 70 kwh. As a result of the small energy savings, the investigators didn't even bother to do a full cost benefit or payback analysis. They concluded that for winter climates, attic radiant barriers result in such a small reduction in total house energy use, they are not a cost effective method of enhancing ceiling insulation.

Moisture Performance

Significant condensation was noted on the underside of the radiant barriers at sub-freezing temperatures, especially where the radiant barrier was laid flat over the insulation. Leakage of warm moist air from the inside condensed and accumulated as frost on the radiant barrier resulting in significant localized accumulations of moisture over the test period. Enough frost was deposited on the foil over a brief cold spell that when the ice melted, water drained back through the insulation to the drywall.

The radiant barrier used had small perforations in it but the moisture did not evaporate through the small perforations quickly enough to prevent liquid drainage. Thus the use of radiant barriers directly over ceiling insulation can increase the frost accumulation and can lead to melt water draining back to the ceiling drywall, causing damage to the ceiling.

Roof Overheating

The radiant barrier reflected energy back to the roof resulting in shingle temperatures that were up to 4°C higher than without the radiant barrier. Roof sheathing temperatures were up to 10°C higher with the radiant barrier than without it. In summer, roof shingle overheating due to radiant barriers is relatively small and does not pose a problem. The increase does not seem to push temperatures high enough, beyond the design temperatures of roof shingles.

The conclusions?

In some circumstances radiant barriers do an effective job, especially if there are significant cooling loads (but these are not often meaningful in a well insulated house). Radiant barriers don't do everything the salesmen say they do.

In new roofs, some concrete tile suppliers encourage the use of radiant barrier materials under the strapping. The recommended material is heavier foil faced kraft sheet. I believe this does a double duty. It is applied over the entire roof, so they form a weather resistant surface to resist any wind driven snow and rain that might find its way under the tiles. In addition, the low emissivity foil face reduces summer heat transfer down into the house (significant, as the concrete mass stores considerable heat).

"Evaluation of the performance of attic radiant barriers" prepared by the Department of Mechanical Engineering, University of Alberta, Edmonton, Alta. with funding provided by Alberta Municipal Affairs.

Advanced House Gets Recognition

A good news story to start the New Year. The Advanced House built in Brampton last year was reviewed in a feature article in the December 1990 issue of **Popular Science** magazine. The Advanced House is a super energy efficient demonstration house that is predicted to use less than half the energy of an R-2000 house (or less than ¼ that of a house built to conventional standards).

A major feature of the Advanced House is its integrated mechanical system - the **SOLMATE** developed by Allen Associates of Toronto. The SOLMATE heats, cools and ventilates the house as well as heating the domestic hot water. In addition, the editors of Popular Science named the SOLMATE one of the year's 100 Best of What's New. You can't buy the unit yet, but we understand that we should be rearing something on this within a few months.

It's good to see Canadian innovations getting recognition abroad.

1991 Consumer Guide to Energy Savings

The 1991 Consumer Guide to Home Energy is a comprehensive, easy to read, easy to follow book that provides, in 250 pages, practical, affordable and easily understandable information on how consumers can make homes more energy efficient, reduce energy consumption, and improve home comfort.

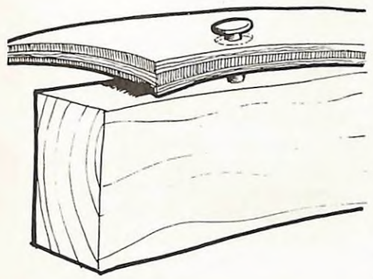
The book lists and rates the energy efficiency of virtually every heating systems and efficient home appliance used today (from light bulbs to furnaces, air conditioners to washing machines) by brand name and model number, in easy to read tables.

While the information applies to US models, it will still be of interest to Canadians as so many products are sold in both countries. It offers a good insight on what energy efficient equipment is available on the market.

The Guide is published by the American Council for an Energy Efficient Economy, a non-profit organization dedicated to advancing energy conservation technologies and policies. The book is available in bookstores throughout the USA.

SOLPLAN REVIEW will also have a limited supply. ($8.35)

Squeaky Floors



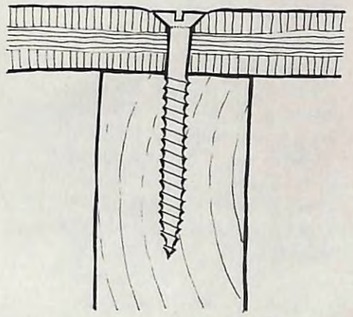
Floors that squeak are a major irritant to homeowners. At least one manufacturer (Trus Joist Corporation) has made quiet floor construction a central feature of their promotion.

Obviously, if you do it correctly the first time, you shouldn't get squeaky floors. Trus Joists are not the only product that will ensure that. One important factor is the use of dry framing materials. A second is to use fasteners and adhesives correctly. If the glue has a chance to bond the subfloor to joists properly, it will do its job. This means putting down the glue bead only just before applying the subfloor panel, and not the way it seems to be done often, where the glue is spread out along a full floor joist, a long while before the sub-floor panelling is installed. This gives the glue time to start drying out. Result? the glue bead is there but it's not doing its job!

Squeaky floors happen because the wood does its thing, which means it is dynamic. As it dries out it shrinks; when there is moisture in the environment, it absorbs it and will swell somewhat. Nails and other metal connectors don't go through this shrinkage, they just stay in place. As the wood shrinks it decreases in volume and appears to push the nails out. This causes the nail pops. The squeaks happen as weight applied on the floor (when someone walks across the floor) rubs the materials against the nail.

The shrinkage is not uniform along the joist, or adjoining joists, so that you have many gaps between the joists and subfloor. The weight of someone walking across the floor pushes the subfloor material against the nails, creating the rubbing that makes the squeaks.

So how do you fix squeaky floors? Using more nails won't do anything for you, because the basic unevenness is still there.



The solution? Probably the best answer I have seen comes from Al Koehli, a Vancouver Housing consultant. Al noticed a furniture finishing screw at the local building materials supplier that will solve the problem of squeaky floors.

The important feature of the screw is that the top section of the screw has no thread, so when the screw is threaded into the floor joist, it pulls down the subfloor. The unthreaded portion provides a 'slip joint', allowing the joist to move slightly. The unthreaded screw won't forcibly rub against the panelling, thus reducing the noise.

Power Smart: B.C. Hydro's Energy Conservation Program

The new social agenda places greater emphasis on environmental concerns. Reduction and recycling, the new buzz words, also apply to housing. For the building industry this means placing more stress on energy conservation. Regular readers know we have been emphasizing this for some time.

Energy conservation means more than just lots of insulation and better windows. It means using techniques and mechanical equipment that has the lowest energy consumption feasible.

There are many things that can be done, but some are more economical than others. There are new technologies and procedures available, but the products and skills to deliver them are not always there when we want them. It's not just a matter of getting the buyer interested in new

technology; trades and suppliers must also be ready to deliver.

A stick or carrot?

What's going to start something happening? The building industry tends to be very slow to adopt change. For the past 6 years we've had the R-2000 program for new residential construction. Because of the program, many new products and skills are now available, but targeted at the new home market.

What about existing housing? The bulk of the housing that is going to be with us into the next century has already been built. The current economic slow down will only encourage homeowners to modify and renovate existing housing rather than rushing into new housing. Perhaps we need to look at something like the R-2000 program for older housing.

The other option may be regulation. Energy codes, already a reality in many parts of the USA will find their way into Canada (BC is now working on a new energy code to be implemented in 1992, Ontario has upgraded insulation standards, other provinces follow). Codes, once in force, generally apply to renovations as well as new construction.

A new factor that is going to have a big impact are the utility energy demand management programs being developed. Utilities have recognized that in many cases it is cheaper for them to encourage the wise use of energy, even if they have to pay for the conservation measures, than to build more power generation capacity. As long as it costs less to reduce a given amount of energy use than the cost of building new generating capacity to meet that demand, then the utility is ahead of the game.

Power Smart Program

It is interesting to look at what is being done by the major utility in British Columbia. B.C. Hydro launched **POWER SMART**, a major multi-year demand side management program 2 years ago. **Power Smart** is the umbrella name for a number of energy conservation programs. They include education programs (for the general public, schools and specific user groups) and specific task programs. Some of them involve outright grants and rebates for equipment or work that must be purchased.

It is significant that the driving force for BC Hydro's aggressive **Power Smart** program is Larry Bell, the utility's new chairman (who came to B.C. Hydro from a major financial institution). Rather than go for more research and development, as is typical with many government programs, they noted that there has already been a lot of research and development activity over the years. It was time to take the lessons learned from others and put them into practice. The result? A commitment of over $200 million dollars to encourage less use of electrical energy.

Other parts of the country will also benefit from the program, as the **Power Smart** program is creating a market for new products. Once manufacturers create new products to meet B.C. demand, they are available to their customers in other parts of the country, and in the process, their cost drops.

One of the first examples was the fluorescent lighting program. The standard fluorescent fixture is the 4 foot 40 watt tube. A 34 watt lamp gives almost the same light output, and has been made in limited quantities for a number of years.

BC Hydro's lighting program promotes the use of the 34 watt lamps. They encouraged a distributor to stock some. In one promotion, they sold several thousand tubes in a week. Encouraged, the distributor ordered some more. These went right way too. So they ordered half a box car load. When these went, the order went to a full box car load. At that point, the manufacturer in Quebec took notice. They hadn't moved so many 34 watt lamps in years. This led to the manufacturer diverting the plant's production to that lamp only, and to a licensing agreement to use the **Power Smart** logo on the lamp. A 6 watt saving may not seem like much, but think of every office, shopping centre and other business place, and how many light fixtures there are. 6 watts per lamp sure adds up!

The lighting program is not just for commercial buildings. Compact fluorescent lamps (SOLPLAN REVIEW No. 24) are now available in a range of sizes (a 7 watt lamp can give more light than a 25 or 40 watt incandescent lamp). The problem with the compact fluorescent lamps is that they need a ballast, so the compact fluorescent light may not fit all light fixtures. However, there are many new residential fixtures appearing on the market that can take these new lamps. As an incentive, to encourage their use, BC Hydro is now giving a $25 rebate for approved light fixtures. As a result you end up paying only a few dollars for approved fixtures. Again, it is stimulating the market, and no reputable manufacturer will ignore the market.

The same thing happened with the Refrigerator program. To encourage efficient fridges (an important base load for the utility) they provided a cash rebate for approved energy efficient models. As an added incentive, salesmen got $5 for each unit sold. The result? 3/4 of all fridges sold in B C are now energy efficient. At first, Canadian manufacturers objected as they did not have product. But within a couple of months they had made modifications, to meet new demand. At first they shipped these models only to B.C. Once the retooling was completed, most of the units were made available to all customers.

Residential Retrofit Program

A residential retrofit program to upgrade electrically heated houses has been launched. The program considers the house as a total system, and includes an audit of the house. If the house qualifies, a grant of up to $1000 plus a $4000 loan at 5% is available to cover the cost of the work. The work covered (in order of priority) includes draftproofing, insulation upgrades, mechanical ventilation, new thermostats and controls, and windows.

To qualify, contractors must take a training course.

An key feature is that there is a performance specification. A fan door test is required before and after, to ensure that there really has been proper draftproofing done to reduce the leakage area as determined by the auditor (typically this will be at least a 30% reduction). The grant and low interest loan is only paid out if the technical criteria are met.

The program was launched October 1, 1990 in a few selected areas, to sort out procedures. So far public reaction has been excellent. Marketing to the selected areas has been aggressive, including telemarketing (where the response has been about 25% of eligible homeowners).

Quality Plus: new home program

The Quality Plus program is the new home program. It follows closely the R-2000 program standards and procedures. In fact, the R-2000 program is a participant in program.

Power Smart: for B.C. Only?

B.C. Hydro's **Power Smart** program is obviously designed to meet the conditions and needs of the utility's customers in its service area. However, many of these programs can be applied in other areas. BC Hydro is working with other Canadian utilities in "franchising" the use of the Power Smart term, so that manufacturers can use the label on their product. That way, consumers will be better able to identify energy efficient products.

Technical Research Committee News

Canadian Home Builders' Association

The goals of the Technical Research Committee (TRC) are to provide a forum for the exchange of information and focus attention on technology problems faced by the housing industry in Canada. Membership includes builder members of CHBA and representatives from industry associations, standards bodies, research agencies, and governments.

Anyone facing a problem or having a technical question is encouraged to contact the local Home Builder's Association technical committee, or to the TRC directly.

To contact the TRC:
Canadian Home Builders Association
200 Elgin St. Suite 502
Ottawa, Ont. K2P 1L5
Tel: (613) 230-3060

Drywall Discolouration

As we reported last issue, the cause of drywall spots has been discovered to be the presence of heavy metal compounds used in joint materials. To confirm that the source of the problem is Phenol mercuric acetate (PMA), a fungicide that was used in some paints or joint compounds, one more laboratory test is being conductedm, and it should be completed by March.

What we know so far is that the PMA (apparently no longer used) was found in some samples of paint and joint compound. Ultraviolet light reacts with the material to create a dark stain. When the compound is exposed to hydrogen sulphide gas (a common air pollutant) it also forms a black stain.

The final tests will also determine the best methods to remove and eliminate the stain. At that time correct remedial action will be known.

U.S. Products

Reports have been received that some building products are being brought into Canada that do not meet Canadian standards. At first it was U.S. manufactured insulation, but it now appears other products are also involved. The Canada-US Free-Trade agreement seems to be encouraging this movement of product.

The issue is not one of keeping out foreign competition, but of ensuring that products in use meet established standards. It is worth noting that Canadian standards are based on a voluntary consensus. All sectors of the industry are involved in drafting and refining the standards. They are not arbitrary, unreasonable and bureaucratically imposed standards.

Canadian manufacturers have an interest not because of a concern about competition, but because unfair competition from products that may not meet stringent standards. Either we relax our standards, or make sure that all products coming into the country meet our standards.

Depending on the type of product and standards that have to be adhered to, failure to use products that meet Canadian standards could have severe results. In the first case, the local inspector can reject any work that does not use materials that meet accepted standards; secondly, even if the inspector has approved its use, should there be a problem and there is cause for action, the insurance companies could refuse to accept liability for insured coverage if they decide that part of the problem was caused because uncertified materials were used.

Anyone encountering non-certified products should contact the TRC and let them know.

Residential Ventilation Issues

Impact Study of CSA F326.1

The CSA standard on residential ventilation (CSA F326.1) has now been adopted as a standard. Due to the changes in the final version of the standard, a revised study to review the cost impact of the standard is being done. It will review the industry survey and system costs that were done in the earlier study. A revised energy costs analysis will be performed.

R-2000 Approved Ventilation Installers

The TRC management committee has recommended that the minimum standard for R-2000 installers be completion of the HRAI ventilation installer course which will include a section on R-2000 technical requirements. The HRAI will have to ensure that the courses are accessible to installers in all the provinces.

How-To Ventilation Manual

As we've reported in the past, a "how-to" manual has been prepared, and is now ready. The manual gives information on what is required for residential ventilation systems, with a special emphasis on practical solutions.
For copies contact: Robin Sinha
Project Implementation Office
CMHC, 682 Montreal Rd.
Ottawa, Ont. K1A 0P7
Tel: (613) 748-2660

Ventilation Task Group

A task group has been formed to review current Canadian ventilation research, identify problems and concerns with current and proposed ventilation requirements, to identify and recommend any necessary future research in the ventilation area, and to provide recommendations to CHBA on ventilation issues.

Members of the group include Bruce Clemmensen (TRC chairman), Richard Lind (TRC builder member), Mike Freedman (mechanical contractor), Robin Sinha and Tom Hamlin from CMHC, and Frank Szadkowski from EMR. One of the priorities will be to prepare a clear cut statement on the objectives of ventilation.

The task group welcomes comment from anyone who has encountered any problems or complaints with ventilation systems: equipment, regulations, or systems design.

CMHC Moisture Study

A survey to determine the moisture content in framing lumber in all parts of the country was done by CMHC inspectors. Moisture was measured in studs and plates in over 280 houses. The interim report showed a wide variation in moisture. Generally, in Eastern Canada there was no dry wood, while in Western Canada there was no wet wood.

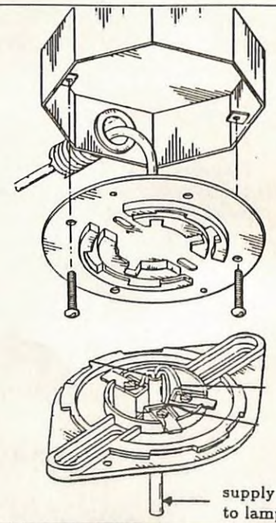
New Products:
Q-Lock Light Fixture Connector

When a new product is launched, there is usually lots of hype associated with it. Often wildly overstated claims are made, praising modest features, promissing to save time, money, etc. We've all heard the stories, and have learned to be sceptical.

Once in a while, the new products really seem to be able to deliver the goods. This is the case with the **Q-Lock** connector for light fixtures.

The **Q-Lock** connector is a new patented device that allows the simple, quick and safe installation or removal of most wall and ceiling residential incandescent fixtures.

The **Q-Lock** connector consists of 2 moulded plastic parts. A low profile base plate is mounted on and covers the electrical box (and is connected to the power). The second is an attachment plate mounted and wired to the light fixture. The electrical connection and fixture mounting is done by a push and twist action that locks the two plates together and completes the electrical connection.



In other words, this not too different from the standard plug in. It will permit non-electricians to safely replace or install a light fixture (assuming the Q-Lock connector is wired in and attached to the fixture). For example, a back-ordered fixture would avoid costly call backs to complete the job if the connector has been pre-wired, as the home owner could do the job themselves.

For the builder, this offers the opportunity of offering a range of lighting fixtures, as lights could be quickly changed.

Are they really all that quick? A demonstration noted that nine typical fixtures took 3 hours 15 minutes to install by conventional means. When the same fixtures were fitted with the connector, they were installed in 45 minutes. If the fixtures had been factory prewired, it would have been even quicker.

The cost? It is estimated to be less than $5.00.

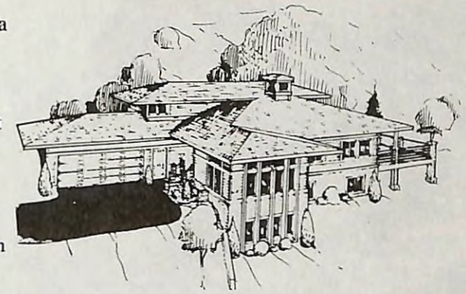
The connector has received CSA certification as a generic hanger for a broad range of fixtures with a rating of 300 watts, 120 v and a maximum fixture weight of 11.3 kg (25 lbs). UL certification is expected imminently.

The designers had their eye on the European market as well, so the unit should meet European standards as well.

As the unit is convenient to use, safe and affordable, it may well become a commonly accepted product in the housing industry.

Information:
Pragmatic Electronics
10819 - 63 Ave.
Edmonton, Alta. T6H 1P9

ReCRAFT Home 90
Innovative Building Technology Demonstration House



ReCRAFT Home 90 is a demonstration house to demonstrate the potential of resource efficiency and use of recycled products. It is to be built in Missoula, Montana this year.

One of the goals is to show that products are already on the market or in development which show potential for resource efficiency while being easily integrated into current construction methods.

The demonstration house is a co-venture between the **Centre for Resourceful Building Technology** and **Southwall Builders**. The builder is absorbing all the costs and risks.

The driving force behind this project is Steve Loken, a home builder from Missoula, Montana. Steve specializes in custom energy efficient home construction, and has been active with the Super Good Cents program in the US North-west for a the past 10 years.

The construction process and subsequent performance will be documented, and a video and handbook are planned.

The 2,400 sq.ft. house has an open floor plan and good south exposure. Designed for a cold climate, the house is bermed into the southwest facing hill side, and is well insulated to reduce heat losses and utility bills.

Maximum use will be made of resource efficient materials, many of which use recycled or upgraded materials. Some of the materials and systems to be used include:
- roof trusses with structural finger jointed truss members
- Parallam hip rafters
- wood/paper fibre board
- remanufactured fibreglass blown-in insulation
- cementitious soffit boards
- fibre-reinforced cementitious lap siding
- water conserving plumbing fixtures
- energy efficient sealed combustion gas water/space heating
- recycled rubber pavers at entry
- natural interior finishes & paints
- pozzolonic fly-ash additive to strengthen concrete in foundation

This is one approach to the environmentally friendly *Green Home* we discussed in the last issue of SOLPLAN REVIEW.

Future growth within the building industry depends on an efficient and sustainable use of both materials and energy. For this reason, we must pay more attention to the concept of *embodied energy* in building products. that looks at the total amount of energy involved in the extraction, refinement, production transportation and final use of the product.

For information about the ReCRAFT 90 Home:
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